REMARKS

As an initial matter, Applicants acknowledge with appreciation the indication that claims 42-44 have been allowed, and that claims 40 and 50 contain allowable subject matter. Claims 6, 7 and 45 stand withdrawn from consideration. Favorable consideration and allowance are respectfully requested for claims 1-5, 8-41 and 46-54 in view of the following remarks.

The rejection of claims 1, 4 and 5 under 35 U.S.C. § 103(a) over Murakawa, JP 2000-294550 in view of Bloom, US 6,228,779 is respectfully traversed.

The invention relates to a thin film forming method wherein a plasma process is used to treat an insulating film that has already been formed on an electronic device substrate. According to the present invention, plasma comprising at least an oxygen atom-containing gas is exposed to a surface of the insulating film whereby oxygen passes through the insulating film to form a second, underlying film at the insulating film-substrate interface.

The method according to the invention can be contrasted with conventional film formation processes, wherein the underlying film is formed on the substrate and the insulating film is formed over the underlying film.

According to the process of claim 1, the surface of an insulating film disposed on an electronic device substrate is irradiated with plasma so as to form a second, underlying film at the interface between the insulating film and the electronic device substrate. The claimed plasma process, wherein plasma

comprising an oxygen atom-containing gas is used to form an underlying film at the insulating film-substrate interface, is not taught or suggested by the cited references.

Murakawa discloses a semiconductor manufacturing method wherein plasma containing oxygen, nitrogen, or oxygen and nitrogen is exposed to a substrate surface to form a first insulating film (21) thereon. A second insulating film, such as a silicon nitride film (22), is formed on the first insulating film (21) using a further plasma process. Murakawa does not disclose, however, irradiating the surface of an already-formed insulating film with plasma to form an underlying film. The deficiencies of Murakawa are not remedied by Bloom.

Bloom relates to the formation of stacked gate dielectric films. The films of Bloom are formed by high temperature thermal nitridation or thermal oxidation, however, and not by a plasma process. One skilled in the art would have had no reason to combine features of Bloom's thermal processes with Murakawa's plasma process. Moreover, even if the references were combined, neither reference teaches a step of forming an underlying film by irradiating the surface of an insulating film with plasma.

The conventional plasma method of Murakawa merely forms a first insulating film on a substrate and forms a second insulating film on the first insulating film. Nothing in the combined teachings of Murakawa or Bloom suggest that a plasma process can be used to successfully form an underlying film at the insulating film-substrate interface by exposing the insulating film to

plasma. In view of the foregoing, reconsideration and withdrawal of the rejection are respectfully requested.

The rejection of claims 3, 8, 11 and 12 under 35 U.S.C. § 103(a) as obvious over Murakawa in view of Bloom, and further in view of Suzuki, US 6,497,783 is respectfully traversed.

Applicants note that claim 3 depends from claim 1 and thus is patentable over the cited references at least for the reasons that claim 1 is patentable. Suzuki, which was cited for teaching that plasma comprises radicals, ions and electrons that are used to process a substrate, fails to remedy the deficiencies of Murakawa and Bloom with respect to claim 1.

As with claim 1, independent claim 8 also recites a process for forming an insulating film. Claim 8 explicitly requires that the surface of an insulating film formed on a substrate is irradiated with oxygen radicals so that the oxygen radicals penetrate the insulating film and react with the substrate to form an oxide film at the interface between the insulating film and the substrate. The cited references fail to disclose or suggest such a process.

As noted above, Murakawa relates to a conventional method of forming a an insulating film wherein a first insulating layer is formed on a substrate using a plasma process, and a second insulating layer is formed on the first insulating layer using a further plasma process. Neither Murakawa nor any of the secondary references teach or suggest that a second, underlying insulating layer can be formed as an interfacial layer between the first layer and the substrate by

irradiating the first layer with radicals that penetrate the first layer. Bloom and Suzuki each fail to provide any teaching that suggests that the plasma process of Murakawa could be modified to form an interfacial layer in the manner required by claim 8, much less that any such modification could be successful. Thus, claim 8 is deemed patentable along with claims 11 and 12, which depend therefrom. Reconsideration and withdrawal of the rejection are respectfully requested.

The rejection of claims 9, 10 and 13-15 under 35 U.S.C. § 103(a) as obvious over Murakawa, Bloom and Suzuki, and further in view of Deboer is respectfully traversed.

Deboer, which was cited for teaching both that the insulating film may be a high dielectric constant insulating film, and that an annealing step can be performed after formation of the insulating film, fails to remedy the deficiencies of Murakawa, Bloom and Suzuki with respect to independent claim 8. Thus, based on their dependency from claim 8, claims 9, 10 and 13-15 are also deemed patentable. Reconsideration and withdrawal of the rejection are respectfully requested.

The rejection of claims 2, 16-28, 46-49 and 51-54 under 35 U.S.C. § 103(a) as obvious over the combination Murakawa and Bloom, and further in view of Deboer, is respectfully traversed.

Independent claim 16 relates to a process for forming an insulating film, comprising, in pertinent part, forming a high-dielectric constant insulating film

on a substrate, and irradiating the surface of the high-dielectric constant insulating film with plasma comprising at least an oxygen atom-containing gas to form an oxide film at the interface between the high-dielectric constant insulating film and the substrate.

Independent claim 46 recites a process for forming an electronic device, comprising, in pertinent part, forming a high-dielectric constant gate insulating film on a substrate, irradiating the surface of the high-dielectric constant gate insulating film with the plasma comprising at least an oxygen atom-containing gas to form an oxide film at the interface between the high-dielectric constant gate insulating film and the substrate, and forming a gate electrode on the high-dielectric constant gate insulating film.

As noted above, Murakawa relates to a conventional plasma-based film formation process wherein a first film is formed on a substrate and a second film is formed on the first film. As acknowledged in the Office Action, Murakawa fails to teach or suggest irradiating the surface of the film formed on the substrate in order to form an oxide film at the interface between the insulating film and the substrate. Bloom and Deboer each fail to remedy this deficiency of Murakawa.

Applicants submit that one skilled in the art would not look to modify the teachings of Murakawa, which relates to plasma processing, based on the teachings of Bloom, which relates to thermal processing. The respective film-formation processes are fundamentally different. Moreover, based on the

fundamental dissimilarity between the processes of Murakawa and Bloom, one skilled in the art would not have had a reasonable expectation that the plasma process of Murakawa could be modified to successfully form an interlayer film based on Bloom's teaching to form an interlayer film using a thermal process.

In view of the foregoing, independent claims 16 and 46, as well as the claims depending therefrom, are deemed patentable, and reconsideration and withdrawal of the rejection are respectfully requested.

The rejection of claims 29-39 and 41 under 35 U.S.C. § 103(a) over Murakawa, Bloom and Deboer, and further in view of Ota, US 6,436,777 is respectfully traversed.

Independent claim 29 relates to a process for forming an insulating film, comprising, in pertinent part, forming an HfSiO film on a substrate, and irradiating the surface of the HfSiO film with plasma comprising at least an oxygen atom-containing gas to form an oxide film at the interface between the HfSiO film and the substrate.

As discussed above with respect to independent claims 1, 8, 16 and 46, the combination of Murakawa and Bloom does not teach or suggest a plasma process that includes forming an insulating film on a substrate, and then irradiating the surface of the previously-formed insulating film with plasma in order to form an interfacial oxide film between the insulating film and the substrate. Because the secondary references of Deboer and Ota fail to remedy the deficiencies of Murakawa and Bloom, claim 29, as well as claims 30-39 and 41, which depend

therefrom, are deemed patentable. Reconsideration and withdrawal of the rejection are respectfully requested.

In view of the foregoing, the application is respectfully submitted to be in condition for allowance, and prompt favorable action thereon is earnestly solicited.

If there are any questions regarding this amendment or the application in general, a telephone call to the undersigned would be appreciated since this should expedite the prosecution of the application for all concerned.

If necessary to effect a timely response, this paper should be considered as a petition for an Extension of Time sufficient to effect a timely response, and please charge any deficiency in fees or credit any overpayments to Deposit Account No. 05-1323 (Docket #101249.55458US).

Respectfully submitted,

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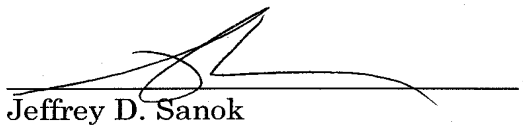

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